Ontology Applications in Homeland Security

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Why Ontology?

**Ontology**: Captures the semantics of a given domain; its concepts, relationship among concepts and attributes describing these concepts.

Uses of Ontology include:

I. Resolution of semantic differences across sources of information and across domains thus, achieving effective information sharing and data integration

II. Reasoning and inference – to identify for example, for a given emergency situation, default actions, resources, roles/responsibilities of relevant agencies.
   - In this case we express the ontology in a formalism which supports automated inferences, e.g., Description Logics
Ontology at DHS – example initiatives: Infrastructure Taxonomy

- **DHS Infrastructure Taxonomy**
  - In protecting the nation’s critical infrastructure, it is important to facilitate communication and dissemination of information.
  - Infrastructure assets are first grouped onto broad infrastructure sectors (e.g., Transportation systems) and further categorized in more details -- up to five levels – sector, subsectors, segment, sub segment, and asset type.
  - For details see DHS-OIP Infrastructure Taxonomy, v4, 2010
Ontology at DHS – Example of use of Ontology at DHS

• **Modeling, Simulation, and Analysis**
  1. Complex Event Modeling, Simulation, and Analysis (CEMSA) Program.
     • Helps achieve dynamic semantic models composability and interoperability Information sharing
  2. UICDS (Unified Incident Command and Decision Support Systems) program
     • A “middleware foundation” for
       – Enabling information sharing and decision support among commercial and government incident management technologies
       – Built to comply with & support NIMS, NRF and ICS
Complex Event Modeling, Simulation, and Analysis (CEMSA)

CEMSA provides DHS analysts with models, simulations, tools, and data to assess the consequences of multiple interacting complex disruptions to critical infrastructure and key resources.

Sponsor
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UICDS: Architecture

UICDS CORE

Integration Services
- Sensor

Personalization & Config. Services
- Agreement
- Notification
- Tasking
- Profile

Incident Mgmt. Services
- Incident Cmd.
- IAP
- Incident Mgmt.
- Resource
- Forms

Info. Mgmt. Services
- Tools Exec.
- Directory
- Product
- Query
- Doc. Mgmt.

Comm. & Message
- Alert
- IM
- Email
- Broadcast
- Pub./subs
- Collaboration

Reference To External Apps.

GIS (External)

Sensor Suite (External)

Resource Mgmt. App. (External)

Service/ Simulation (External)

External DB

Data Service (External)

Agent Network

TCP/IP Network

OGC – WMS, WFS

OGC – SOS

EDXL – RM

OGC – WPS

Adapter

User Agent

UI

App. Adapter

External Incident Mgmt. Application

User

HTTP, SOAP, WSDL, NIEM, EDXL-RM, Atom, WS-Notification, WS-Topic, UICDS IEP, CAP
Ontology - Challenges

• Ontology development – Human intensive
• Validation and gaining user credibility
• Ontology update
• Ontology integration